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August 16, 2018

BY ELECTRONIC DELIVERY

Marlene H. Dortch, Secretary
Federal Communications Commission
445 12th Street S.W.
Washington D.C. 20554

Re: Permitted Oral *Ex Parte* Notice
Wireless E911 Location Accuracy Requirements
PS Docket No. 07-114

Dear Ms. Dortch:

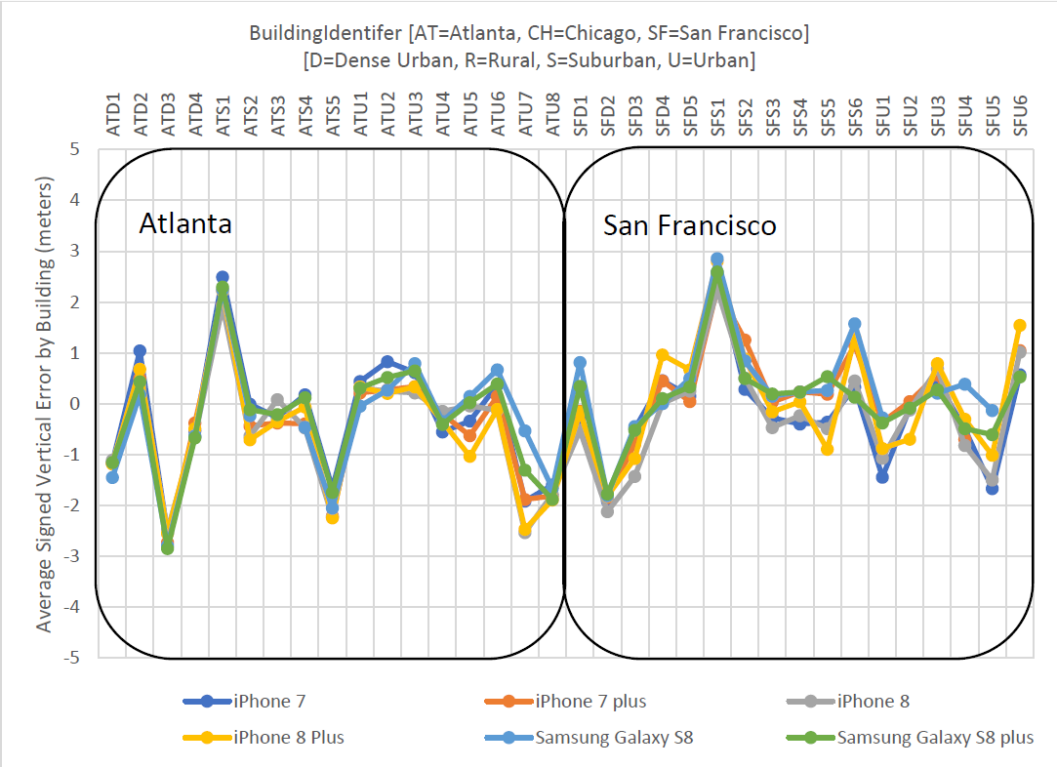
On August 14, 2018, representatives of NextNav, LLC ("NextNav") participated in a meeting with Commission staff representing the office of Chairman Pai and the Public Safety and Homeland Security Bureau ("PSHSB"). Participating in the meeting on behalf of the Commission were Zenji Nakazawa, Chairman Pai's Public Safety and Consumer Protection Advisor; Lisa Fowlkes, PSHSB Chief; David Furth, PSHSB Deputy Bureau Chief; and PSHSB staff including Rasoul Safavian, Austin Randazzo, John Evanoff and Nellie Foosaner. Participating in the meetings on behalf of NextNav were Gary Parsons, Executive Chairman; Ganesh Pattabiraman, CEO and Co-Founder; Bruce Cox, Senior Director, Regulatory & Public Safety; and the undersigned. The attached presentation was discussed during the meeting.

The purpose of the meeting was to address the results of the recently-completed z-axis test bed and the characterization of the test results that was presented to the Commission by CTIA.[1] The z-axis test bed reaffirmed the significant accuracy of NextNav's Metropolitan Beacon System ("MBS") technology, documenting vertical location accuracy of 1.8 meters or better for 80 percent of fixes and 3 meter or better accuracy for 94 percent of fixes, *i.e.*, "floor level" accuracy.

As shown in the figure below, NextNav's test results showed very little variation in the accuracy of its MBS technology despite testing in a wide range of morphologies and environments.

[1] *See* Letter from Scott K. Bergmann, Senior Vice President, Regulatory Affairs, CTIA, *et al.*, to Marlene H. Dortch, Secretary, Federal Communications Commission, PS Docket No. 07-114 (Aug. 3, 2018) ("*CTIA Letter*").

The test results were also very consistent with the z-axis results that NextNav's MBS technology has demonstrated in two prior independently-managed test beds.[2]



NextNav has repeatedly and consistently demonstrated that its technology can provide floor level accuracy within 3 meters in multiple test beds conducted over more than five years. These results achieve the goals of the public safety community, which has explained to the Commission that floor level vertical accuracy "is valuable in large multi-story structures common in urban and dense urban morphologies."[3] The significant value of floor level location information was demonstrated by San Francisco fire officials when they conducted exercises in July 2014 to

[2] *See generally* Letter from Bruce A. Olcott, Counsel, NextNav, LLC, to Marlene H. Dortch, Secretary, Federal Communications Commission, PS Docket No. 07-114 (Aug. 14, 2013) (providing results of NextNav's Rev.2 indoor location testing and comparing them with the accuracy of NextNav's z-axis results from the initial test bed).

[3] *See "Indoor Location Test Bed Report*," CSRIC III, Working Group 3, *Public Safety Forward* at 8 (March 14, 2013) ("*First CSRIC Test Bed Report*").

test the impact that floor level vertical location information can have on search and rescue efforts in large buildings.[4] The test results showed a significant improvement in search times when first responders were provided access to accurate vertical location information, greatly improving the effectiveness of emergency response and the health outcomes for victims.[5]

The comprehensive results from CTIA's 2018 Stage-Z testing fully validated prior test results from CTIA's 2016 Stage-2 testing and CSRIC's 2012 testing, and provide a sufficient base of test data for the Commission to establish the z-axis accuracy metric envisioned in the Commission's *Fourth Report and Order*.[6] In seeking additional rounds of testing prior to establishing an accuracy metric, however, CTIA expresses a number of concerns.

First, CTIA argues that additional testing is needed because NextNav was not able to participate in the belatedly scheduled z-axis tests that were conducted in Chicago.[7] Although the Emergency Services Interconnection Forum of the Alliance for Telecommunications Industry Solutions ("ATIS") had recommended that some testing be conducted in a northern city,[8] an actual decision to locate the testing in Chicago and the associated test neighborhoods was not announced until September 2017, with the testing then scheduled for November 2017, providing insufficient time for NextNav to deploy its network in that market.

In any event, the Chicago tests that were conducted did not produce any novel results. For example, as shown in the figure below, the z-axis results for Polaris' indoor location technology were arguably better in Chicago than Polaris' results for San Francisco.

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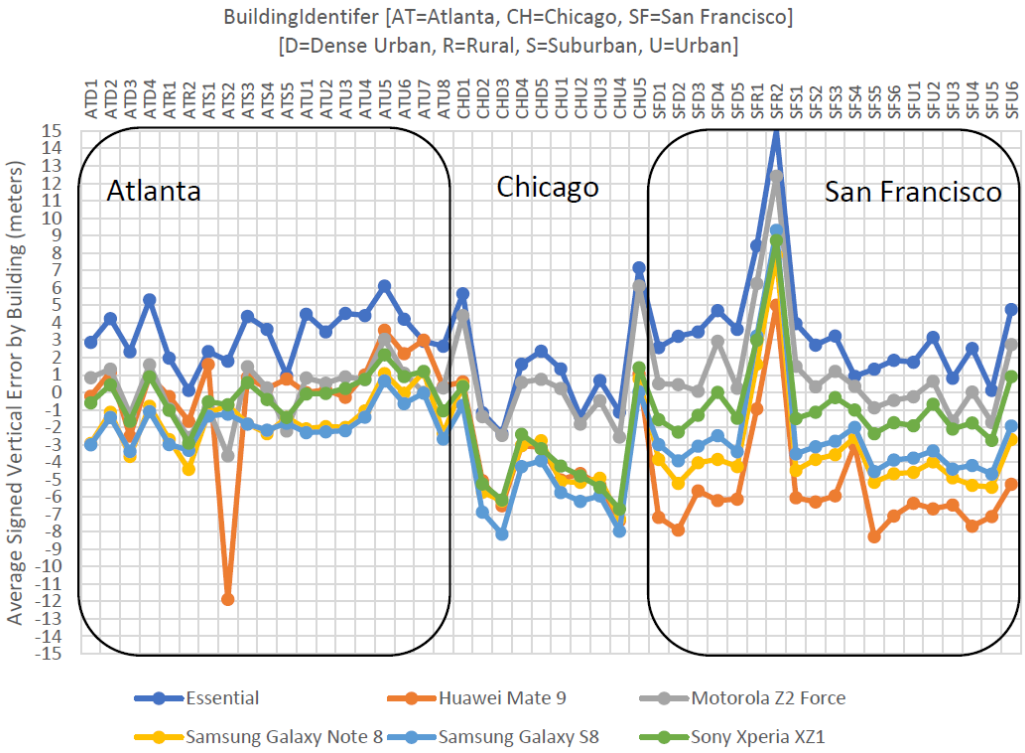
[4] *See* Letter from William Storti, Battalion Chief, San Francisco Fire Dept., *et al*. to Marlene H. Dortch, Secretary, Federal Communications Commission, PS Docket No. 07-114 (July 14, 2014).

[5] *See id.* at 2 (showing reductions in search times from approximately 19 minutes down to approximately 2 minutes and from approximately 7 minutes down to approximately 3.5 minutes).

[6] Wireless E911 Location Accuracy Requirements, *Fourth Report and Order*, 30 FCC Rcd 1259, ¶ 162 (2015) ("*Fourth Report and Order*") (explaining that "by providing a z-axis metric as a backstop to dispatchable location for identifying *floor level* of 911 calls from multi-story buildings, we ensure that vertical location accuracy is achieved within the timeframe laid out by the Roadmap") (*emphasis added)*.

[7] *CTIA Letter* at 3.

[8] *See* ATIS-0500030, *Guidelines for Testing Barometric Pressure-Based z-axis Solution*, at 4 (May 2016).



ATIS had suggested the possibility of testing in a northern city to determine the potential effects of extremely cold weather,[9] and internal delays by the testing house in commencing the test activity until February 2018 avoided some of the coldest days in both Atlanta and Chicago. Although the Report notes that "extreme weather" and "every possible indoor environment" were not encountered, however, the Report also states that a "reasonably comprehensive" selection of regions, buildings, test points and weather conditions were captured in the results.[10] The Report's own findings note that material variations in performance were *not* noted among different regions, or for that matter, among varying morphologies within regions.[11]

Second, one of the test environments included a 24-hour test to determine variability on a time-of-day basis as HVAC systems cycle to retain stable indoor temperature with varying outdoor

[9] *See id.*

[10] *See Report on Stage Z*, 911 Location Test Bed, LLC PS Docket 07-114, at 3 (Aug. 3, 2018), *included as attachment to CTIA Letter* ("*Report*").

[11] *See id.* at 100.

environments.[12] CTIA notes these modest variations (see charts 9.36 and 9.38 below) and speculates that those variations should potentially be *additive* to the test results.[13] However, the normal test process itself involved various times of the day, in differing HVAC cycles and weather and temperature conditions, such that much of the time-of-day and weather fluctuation is already captured within the body of the test results. The modest time-of-day fluctuation that was exhibited can reasonably be contained within a vertical error budget of 3 meters for 80 percent of fixes, as the Commission and the public safety community originally proposed.

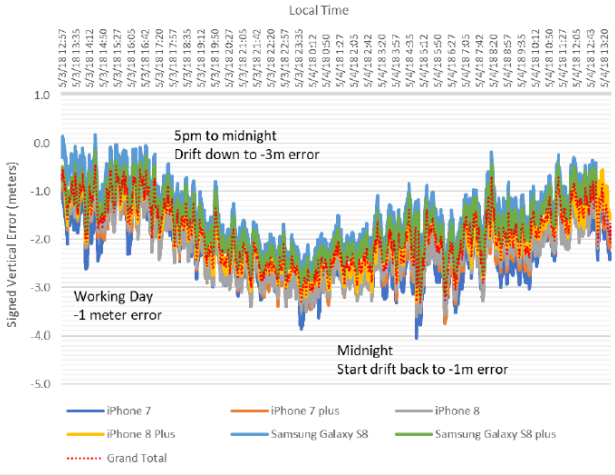


Figure 9.38 – Atlanta 24-hour Collect Signed Vertical Error vs. Time – NextNav devices

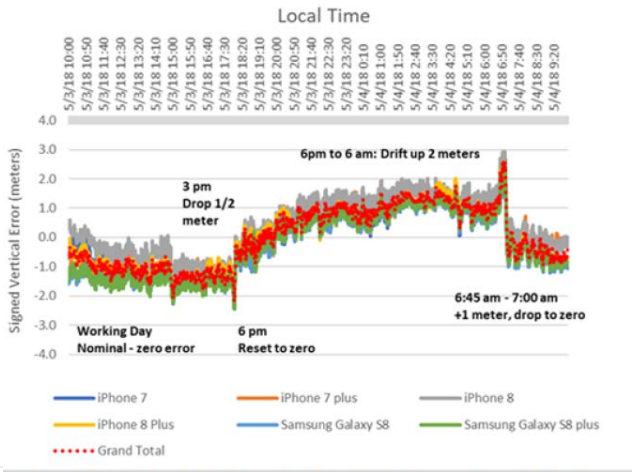


Figure 9.36 – San Francisco 24-hour Collect Signed Vertical Error vs. Time – NextNav devices

Third, CTIA argues that additional testing is needed because NextNav was not able to participate in the rural environments selected for the z-axis test bed.[14] NextNav's MBS technology was tested for vertical accuracy in rural areas during the original CSRIC test bed conducted in the winter of 2012 and NextNav's results from that testing fell well within an accuracy level of 3 meters for 80 percent of all calls.[15] It is also unclear what benefit would result from such testing. The Commission's location accuracy rules require wireless carriers to deploy z-axis capabilities only in the top 50 CMAs, outside of which the presence of high rise structures is not significant, making a rural z-axis solution arguably not as critical.

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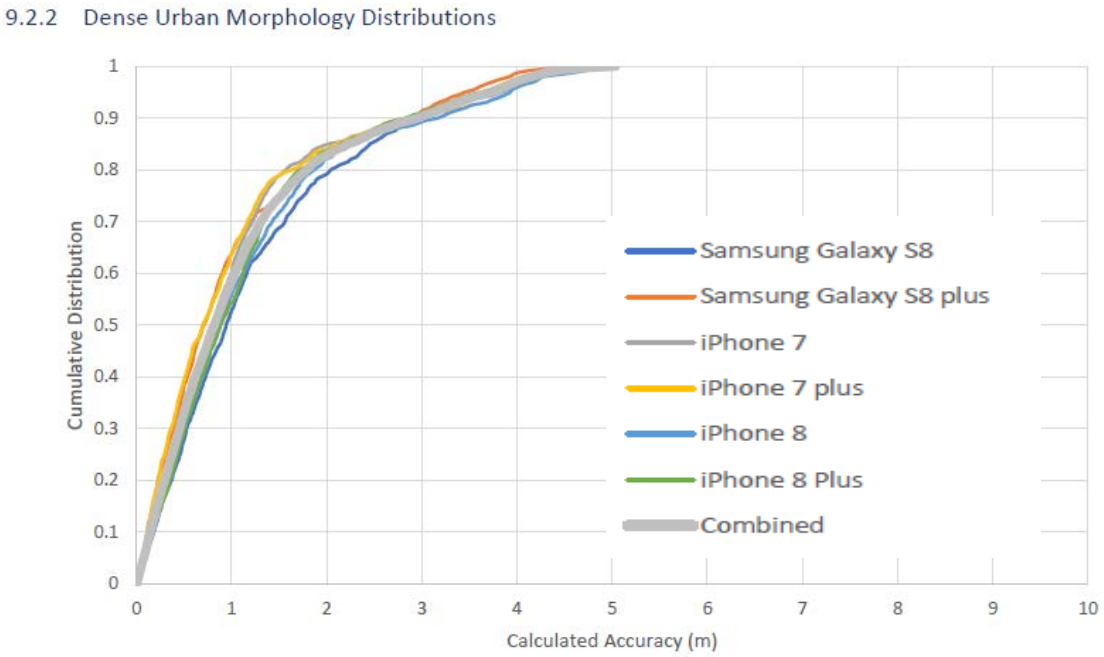
[12] *See id.* at 102.

[13] *See id.* at 103.

[14] *See CTIA Letter* at 3.

[15] *See First CSRIC Test Bed Report* at 36-37.

Fourth, CTIA argues that further investigation may be needed into the vertical location capabilities of older wireless handsets, arguing that the accuracy of barometric pressure sensors degrades with age.[16] The recent z-axis test process, however, employed both older and newer handsets and identified no degradation in location capabilities for the older devices as observed from the charts below.



Finally, CTIA raises concerns about the fact that, although commercially-available handsets were used in the z-axis test bed, they were supplemented with additional software to replicate the capabilities of the NextNav and Polaris solutions. Thus, CTIA expresses concern that, "[n]o actual calls were placed to produce any z-axis fixes, and standardized 9-1-1 signaling was not used."[17] It must be noted, however, that the appropriate signaling to support barometric based altitude determination from the device to the network is already standardized in 3GPP (Rel 13/14) and OMA. As such, all elements required to commercially scale either solution exist today and simply need carrier and device manufacturer support to include appropriate calibration software within new handsets.

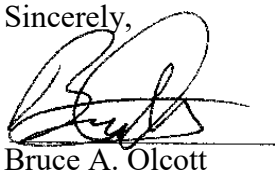
[16] *See CTIA Letter* at 3-4.

[17] *Id.*

In summary, the results of the recently concluded z-axis test bed, combined with the results of multiple other test beds conducted by CTIA, CSRIC and other independent and expert administrators, clearly demonstrate that technologies are available today (and others are being developed) that can provide floor level vertical accuracy of within 3 meters for at least 80 percent of wireless calls. The public safety community has clearly communicated its desire for floor level vertical accuracy in major cities, and the body of independent test results over the past five years demonstrates that such accuracy is clearly achievable. We look forward to the Commission completing its public comment process for the z-axis report and adopting a Commission-approved vertical location metric in a timely manner consistent with the *Fourth Report and Order*. Having a clearly delineated vertical accuracy objective to supplement the dispatchable location approach to vertical will expedite the availability of this important public safety capability.

Please contact the undersigned if you have any questions about this matter.

Sincerely,



Bruce A. Olcott

cc: Zenji Nakazawa
Lisa Fowlkes
David Furth
Rasoul Safavian
Austin Randazzo
John Evanoff
Nellie Foosaner

Attachment

NextNav, LLC

Z-Axis Test Bed Report

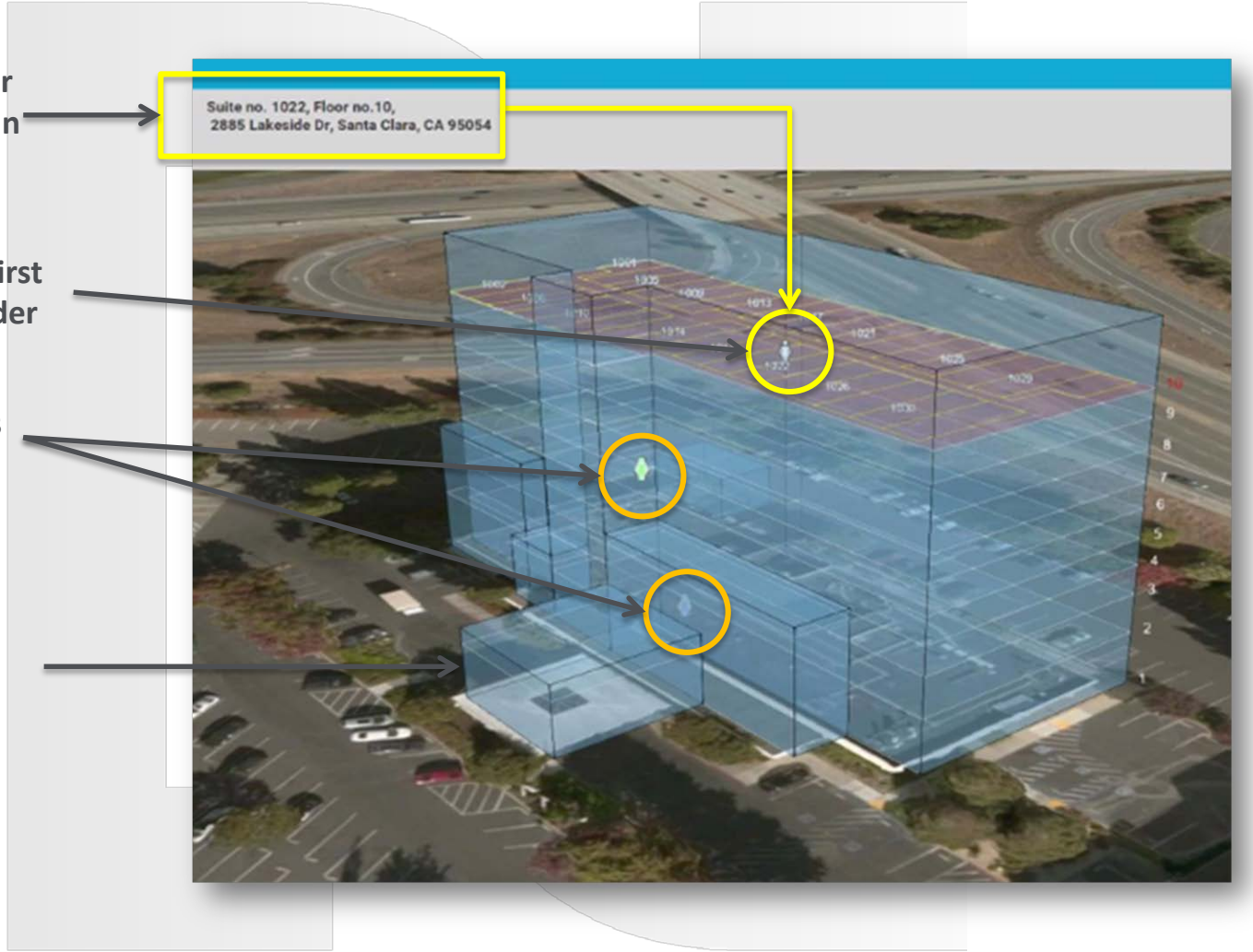
August 2018

NextNav's Metropolitan Beacon System ("MBS")

- Overlay network dedicated to position, navigation and timing ("PNT")
  - Includes X,Y & Z axis and timing, with unique, proven floor-level vertical and horizontal accuracy
- Serves indoor and urban areas - complementary to GPS
- Wide-area coverage with unlimited capacity – can cover an entire metro
- Long-range, low-cost broadcast beacons placed on cell towers and rooftops – not building specific
  - Similar to GPS in that it serves all applications
- Deployed and managed to deliver 'Mission Critical' location with multi-layer reliability and immune to GPS disruptions
  - Network & beacon redundancy
  - Battery backup to ensure continuity during power outage
  - Encrypted signal
  - Resistant to GPS outage
- Designed to be integrated into mass market devices
- Proven "best in class" in various CTIA/ATIS, FCC-sponsored trials

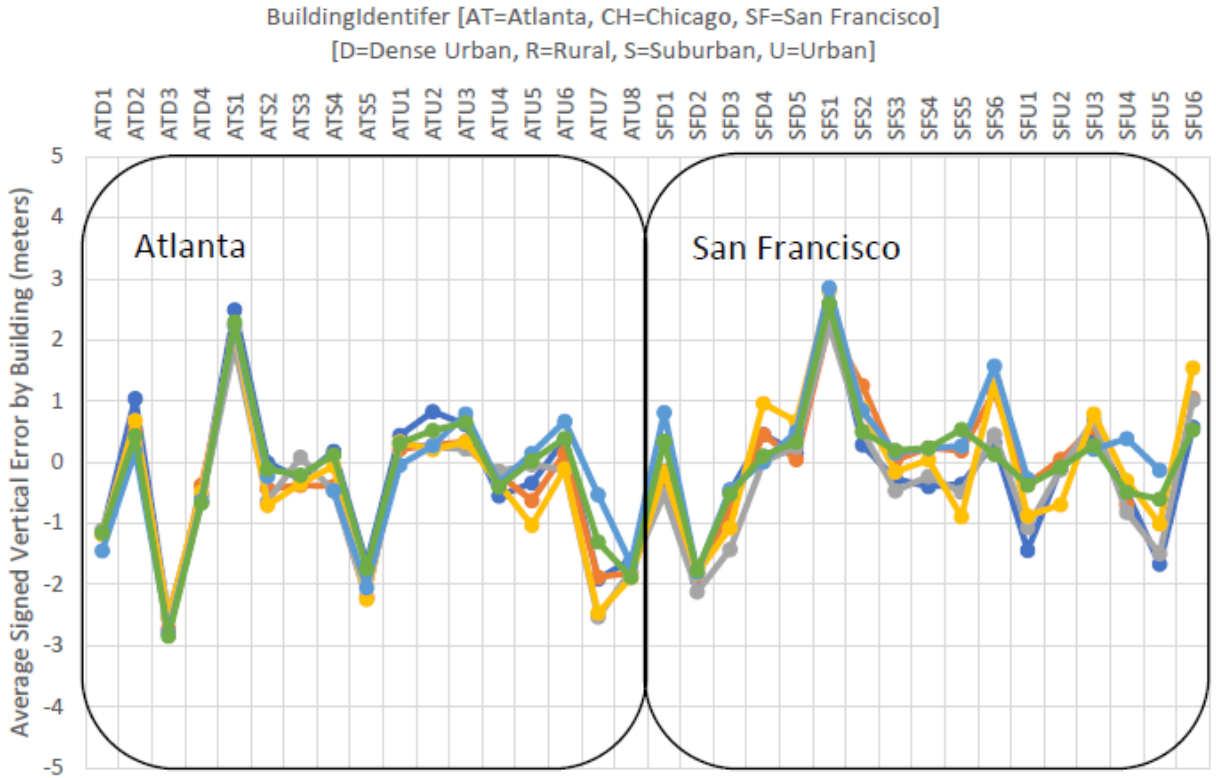
MBS is essentially a network of low-cost terrestrial "satellites" broadcasting from roof-tops and towers

3D Geolocation and Situational Awareness for Public Safety



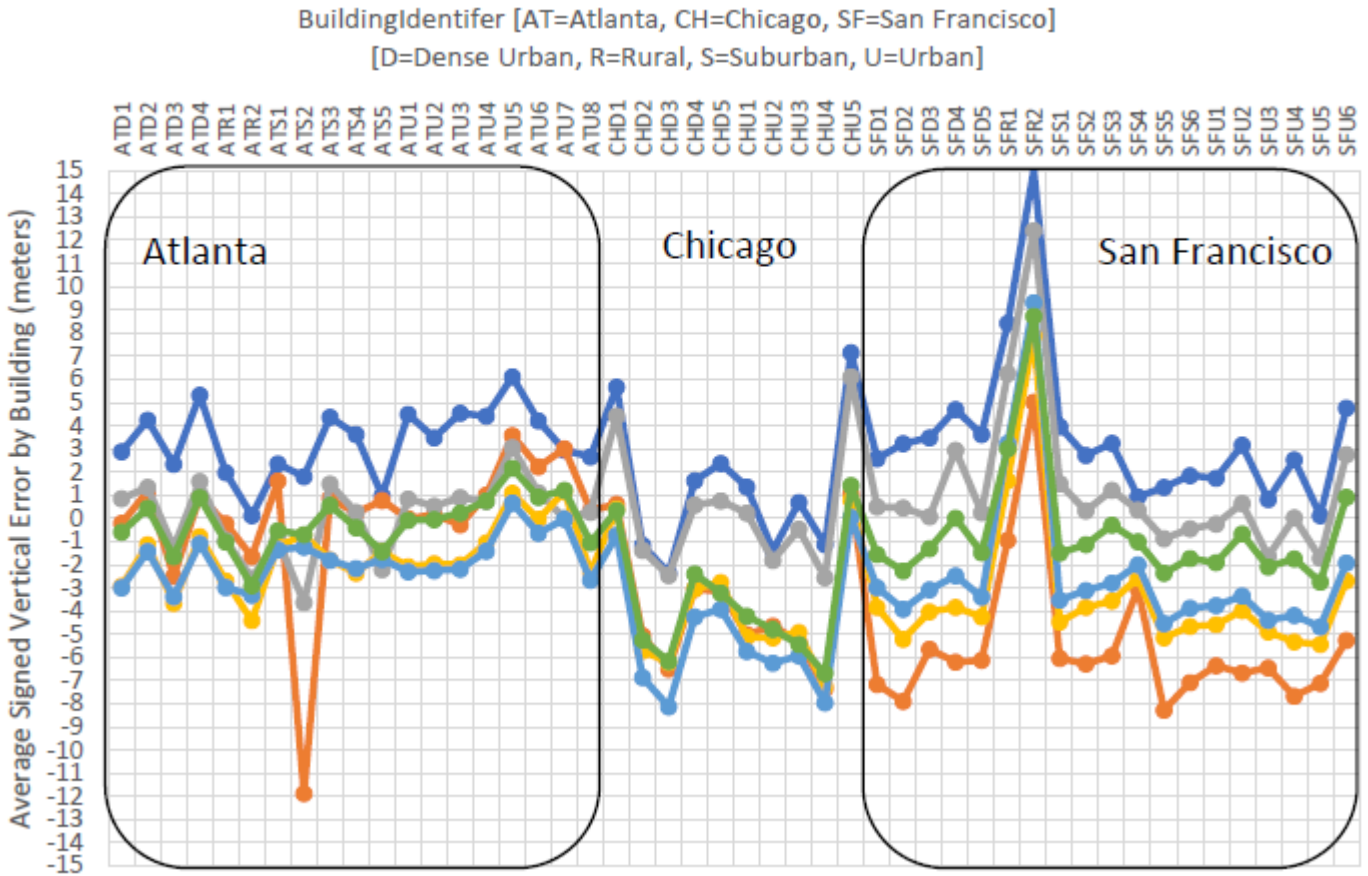
NextNav's MBS Network – Z-Axis Test Bed Results

- NextNav's MBS network provided vertical accuracy of 1.8 meters or better for 80% of fixes, and 3 meters or better for 94% of fixes (i.e., Floor Level)
  - These results are consistent with NextNav's results in previous independently conducted test beds
- The variations in these results were less than 1.0 meter in nearly all tested locations
  - No basis exists to suggest that NextNav's results might be different in additional test locations



Z-Axis Test Bed Results – Chicago

- The Z-Axis test results for Polaris provide further evidence that the late addition of the Chicago test locations did not introduce appreciable variability
  - In fact, Polaris arguably performed better in Chicago than in San Francisco



Z-Axis Test Bed – Daily Variations in Pressure

- Fluctuations resulting from weather, time of day, and HVAC cycling induced errors that were modest and contained within an error budget of 3 meters for 80% of fixes
  - The Report is incorrect in asserting these daily pressure changes must be treated as additional error sources that should be taken in to account *beyond* the accuracy statistics in the Report
  - Since normal testing occurred at various points throughout the day, some element of time-of-day variability (whether positive or negative) is already included in the test results

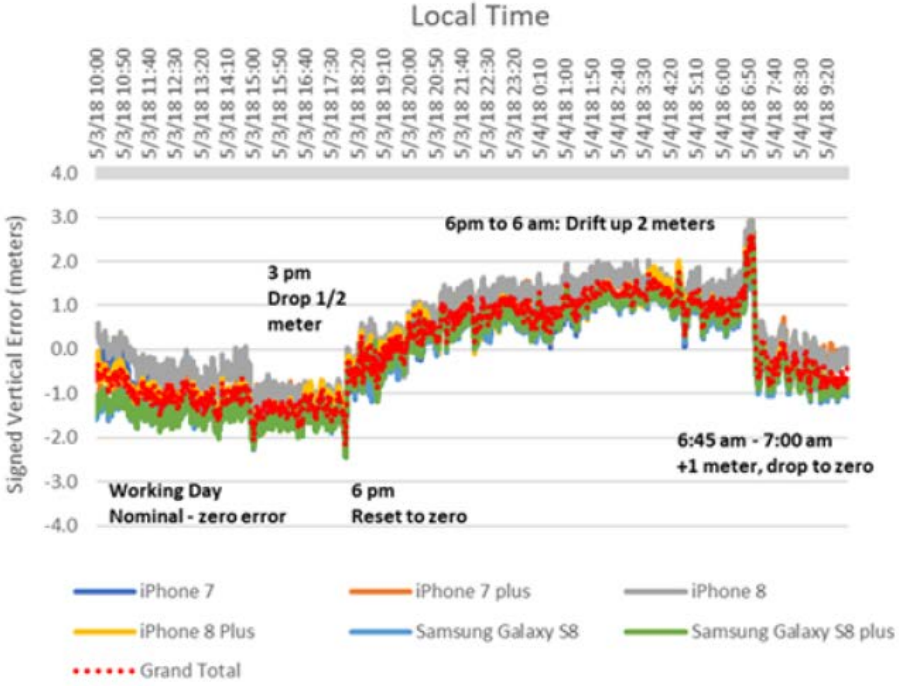


Figure 9.36 – San Francisco 24-hour Collect Signed Vertical Error vs. Time – NextNav devic

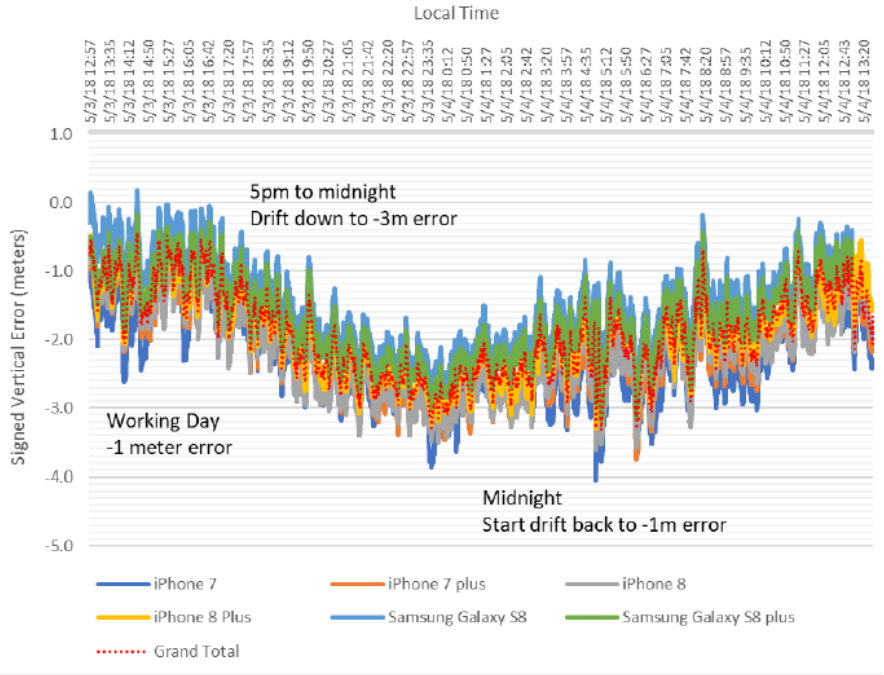
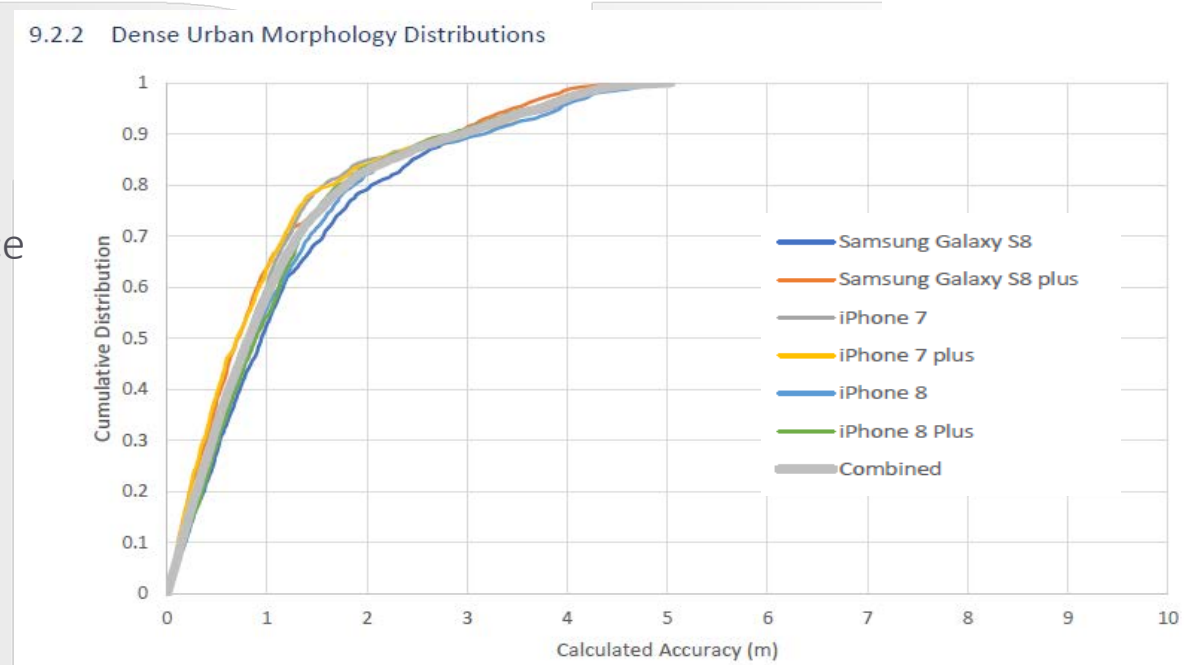


Figure 9.38 – Atlanta 24-hour Collect Signed Vertical Error vs. Time – NextNav devices

Z-Axis Test Bed Results – Other Considerations

- Major ‘mass market’ devices spanning different models and years showed consistency in performance
  - Handsets made in 2016 performed just as well as new handsets (no difference in calibration efficacy)



- The fact that NextNav’s Z-Axis technology was not tested in rural areas is irrelevant
  - The FCC has not adopted any requirements for Z-Axis accuracy in rural areas
  - In 2012 CSRIC trials, NextNav’s Z-Axis results in rural areas were comparable to other morphologies
- MBS technology and all aspects required for barometric based sensor calibration have been standardized in 3GPP (Rel 13/Rel 14) and OMA SUPL 2.0.3 onwards
  - Technology as tested and approach is commercially scalable

Z-Axis Test Bed Overall Results

- The significant capabilities and 'floor level' accuracy of NextNav's Z-Axis technology has remained consistent in all morphologies and test conditions over multiple test campaigns across multiple years in multiple cities and regions, with multiple different handsets and sensor manufacturers
- Periodic background calibration is not essential, but accurate sensor management (however achieved) and a precision reference network are essential for consistency in performance
- The Z-Axis Test Report showed little variability in results based on differing morphologies, differing building construction types and differing weather conditions, indicating nationwide applicability of the data
- The Test Report notes that although 'extreme weather' and 'every possible indoor environment' were not encountered, the test results do reflect a 'reasonably comprehensive' selection of regions, buildings, test points and weather conditions
- The Test Report expressed carrier concerns about commercial scalability and facilitating sensor calibration software in future handsets, but the test results clearly demonstrate the technical viability of floor level vertical location accuracy using only handset software and a precision local altitude reference network